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Research Article

Dynamic Mechanisms of the Environmental Effects of FDI: An Empirical Test Based on the PVAR Model

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This study selected relevant data of China from 2006 to 2019 and adopted a panel vector autoregression (PVAR) model to conduct an empirical analysis on the dynamic mechanism of a series of problems including "FDI (foreign direct investment), economic scale, and environmental pollution," "FDI, industrial structure, and environmental pollution," and "FDI, production technology, and environmental pollution." Our research results showed that there are differences in the optimal lag order under different conditions, such as under the action mechanism of economic scale and industrial structure, and the optimal lag order was 1, while under the action mechanism of production technology, its value was 2. FDI had a long-term effect on the environment; under the dual-action mechanism of economic scale and industrial structure, the environmental effect of FDI reached the maximum within 2 periods, the effect lasted a relatively long time, and the response of environmental pollution to the technological level reached the maximum between the fourth period and the sixth period. In terms of the overall situation in China, the FDI did not produce an obvious effect on environmental pollution; on the contrary, it exhibited a trend of environmental improvement, which varied with the action mechanism and the region; and also, the improvement of technological level can also significantly improve the quality of environment.

1. Introduction

In the past decades, as the flow speed of international capital was accelerating and the global environmental problem was becoming increasingly serious, the relationship between foreign direct investment (FDI) and environmental pollution has attracted the eyes of field scholars around the world. Now the global economic situation is very complicated; there are more uncertainties during economic development; in this context, China has proposed to promote the high-quality development of economy; and such "high quality" covers multiple aspects including technological innovation, industrial structure upgrade, product added value increase, and the status improvement of value chain. During the high-quality development process, we will have to face the challenges of replacing old growth drivers with new ones and solving contradictions between environmental protection and economic development, and between fairness and efficiency. In these contradictory relationships, how does FDI affect the economic scale, industrial structure, and technological level? What is the dynamic mechanism by which FDI affects the ecological environment in these three aspects?

This study took China as the research object and empirically studied the environmental effects of FDI in the country. At first, this study reviewed relevant literature and analyzed the change trends and features of FDI and environmental pollution in China since 2006. In the benchmark analysis, this study built three models for "FDI, economic scale, and environmental pollution," "FDI, industrial structure, and environmental pollution," and "FDI, production technology, and environmental pollution," and employed the PVAR model to study the three dynamic mechanisms between FDI and environment, including the appearance time, turning point, and time lag of the scale effect, technological effect, and structural effect; also, the regional differences of the environmental effects of FDI had been analyzed. This study extended the research on the environmental effects of FDI on the host country and upgraded the static analysis of total effect to the dynamic analysis of time points, thereby deepening and enriching our understanding of the environmental effects of FDI and its action mechanisms. In the end of the text, this study proposed a few suggestions for the policy-making of the government based on the research conclusions obtained from the case study of China.

2. Literature Review

2.1. Two Hypotheses about FDI's Environmental Effects on Host Country. There are many studies on FDI's environmental effects; according to the research conclusions, they can be divided into two types: the pollution haven hypothesis and the pollution halo hypothesis.

The pollution haven hypothesis holds that developed countries generally have stricter environmental control standards and higher pollution control costs; in contrast, the requirements of developing countries for environmental protection standards are lower; and as a result, accompanied by foreign investments, the high-polluting industries of developed countries will gradually relocate to developing countries, leading to a decline in the environmental quality of the host country [1, 2]. Since the pollution haven hypothesis had been proposed, field scholars took ASEAN (Association of Southeast Asian Nations), Latin America, and other regions in the world as research objects to study global countries with high-, middle-, and low-income levels; they adopted research methods such as PMG-based dynamic panel model, fixed-effect panel model, and random-effect panel model to prove the pollution halo effect [3–5]; and from a few perspectives of pollution control costs, environmental control standards, and capital accumulation, they demonstrated the viewpoint that FDI can aggravate the environmental pollution of the host country.

The pollution halo hypothesis holds that MNEs (multinational enterprises) generally have complete pollution control technologies and environmental management standards, and introducing foreign investors is helpful for the host country to promote more advanced pollution control technologies and environmental management systems to domestic firms, who can then apply more green production technologies and optimize their environmental management measures. Through the spillover effect on technology and management brought about by MNEs, the host country can upgrade the environmental protection level of the country. Some scholars also argued that foreign investment has a demonstrative effect on domestic firms of the host country, and FDI can promote the advancement of the pollution control technologies of the host country and improve its environmental quality to varying degrees [6–8].

In terms of research method selection, most existing studies chose the autoregressive distributed lag (ADL) model in researching the assumption of the environmental Kuznets curve (EKC), and the results proved that this assumption is true for some regions [9, 10]. Some scholars chose to use the spatial lag model (SLM) and spatial error model (SEM) in their studies and found that there is a significant spatial autocorrelation between FDI and environmental pollution level, both of which showed an obvious path-dependent feature, which had confirmed the pollution haven hypothesis [11].

In terms of the problem of whether FDI has an impact on the host country's environment, existing studies constructed measurement models and adopted significance test to study the problem, but they can only answer it with "yes" or "no," and for more questions like this, is the impact of FDI on the host country's environment fast or slow? Strong or weak? Long or short? They have no answer yet.

2.2. The Action Mechanisms of FDI on Environment. Some scholars believe that the impact of FDI on the host country's environment is complex and multidimensional, and the environmental effects obtained under different conditions are different as well. Through research, they discovered that the environmental effects of FDI on the environment vary with the host country's economic level, industrial structure, and environmental policies [12–14].

According to the analysis framework of Grossman and Krueger [15], the environmental effects of foreign investment on the host country can be decomposed into three categories: first, the scale effect, which means that the inflow of FDI will trigger the host country to expand its production scale, thereby increasing pollution emissions; second, the structural effect, which means that, as foreign investment enters the host country, the industrial structure will shift from the primary industry-oriented structure to the secondary industry-oriented structure, and this process will increase pollution emissions; later, as the industrial structure continues to shift to low-polluting industries: the service industry and the knowledge-intensive industry, the emissions for per unit output will decrease accordingly; third, the technological effect, which means that the technology spillover effect brought by foreign investment will make the production technologies of the host country to transform to greener and cleaner technologies, thereby reducing the pollutant emissions. The action mechanisms of FDI's environmental effects on the host country are shown in Figure 1.

Field scholars have attained fruitful research results on the scale effect, and some scholars studied the causal relationship between FDI, economic growth, and environmental conditions. For example, Hammami [16] adopted the VAR panel data model to study the data of 17 Middle East and North African countries from 1990 to 2012 and found that there is a one-way causal relationship between FDI stocks and CO_2 emissions to economic growth. Moreover, with the help of a dynamic simultaneous equation model and GMM, Hammami [17] drew the conclusions that there are two-way causal relationships between economic growth and FDI inflow, between economic growth and CO_2 emissions, and between FDI inflow and CO_2 emissions. Based on the data of Vietnam, Phuong and Tuyen [18] analyzed the data of 4-order lagging, and their research results showed that there are causal relationships among CO_2 emissions, FDI, and economic growth. The relationships among economic

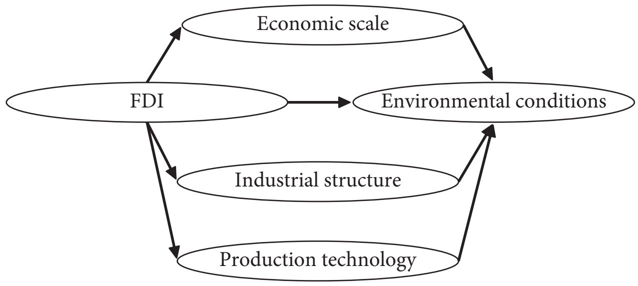

Figure 1: The action mechanisms of FDI's environmental effects on the host country.

growth, FDI, and CO_2 emissions are nonlinear. In most cases, they conform to the EKC hypothesis. FDI can increase CO_2 emissions via the scale effect and the structural effect.

However, few studies have talked about the structural effect or the technological effect, and those concerned about the three action mechanisms are even fewer.

3. Trends and Features of China's FDI and Environmental Pollution

In 2004, the amount of FDI that had been actually used in China was 60.63 billion US dollars, of which the amount used by foreign-invested enterprises accounted for the highest proportion of 66.34%; followed by the amount used by joint-stock ventures, accounting for 27.03%; and the proportions of FDI used by cooperative ventures, foreign-invested joint-stock enterprises, and cooperative development were relatively low. By 2020, the amount of FDI actually used in China was 144.37 billion US dollars, the proportion of FDI used by foreign-invested enterprises increased by 3.37%, and the proportion used by foreign-invested joint-stock enterprises increased by 3.66%, while the proportion used by joint-stock ventures decreased. From the perspective of the industries that the FDI had flowed into, in 2004, nearly three-quarters of FDI entered the manufacturing industry, and the direction was quite concentrated; while in 2020, the flow directions of FDI became more scattered, wherein the manufacturing industry accounted for 21%; the proportion of information transmission, computer service, and software industries increased by 14.45%; and the proportion of leasing and business service, scientific research, and technical service industries and the proportion of geological exploration, real estate, and transportation industries both increased as well. Between 2004 and 2020, the FDI introduced into China increased fast, and the FDI was mainly used by foreign-invested enterprises and joint-stock ventures; while in recent years, the proportion of FDI used by foreign-invested joint-stock enterprises increased to some extent. In addition, during the development process of this decade, the FDI introduced into China was distributed in more industries, and the proportion of the manufacturing industry decreased fast. Figure 2 shows the specific data, which are quoted from the China Statistical Yearbook. Since the China Statistical Yearbook has only been updated to 2020, the detailed data in Figure 3 are only updated to 2019. Now the quarterly data of basic

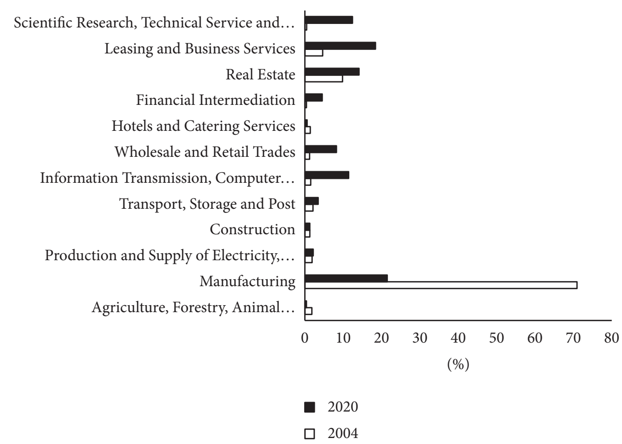

Figure 2: Distribution of China's FDI in different industries.

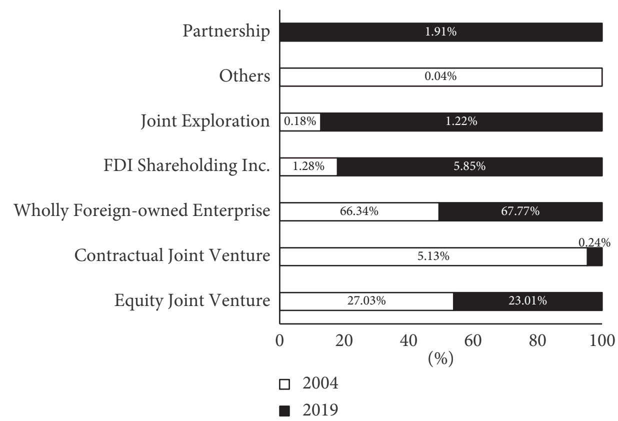

Figure 3: Proportions of FDI used by enterprises of different ownership types in China.

national economy statistics released by the Chinese government only involve agriculture, industry, and construction industries, so we could not get the latest quarterly data of FDI, and the data of the year 2021 will be released in early 2023.

Since the reform and opening-up policy had been implemented in China in 1978, the Chinese government has attached great importance to economic construction, and the GDP growth rate had remained above 8.00% for quite a long time. However, what comes together with the fast economic growth is the environmental pollution, which gets worse over time these years. In 2004, the Chinese government determined to take ecological and cultural construction as a strategic task and building a moderately prosperous society in an all-round way as a new objective. Since then, the environmental protection system, institutions, and measures have been developed and improved continuously in China; the enforcement of the environmental protection law has been strengthened; and the degree of environmental pollution has abated to some extent. The SO_2 emissions decreased from 22.55 million tons in 2004 to 8.75 million tons in 2020, with a drop of more than 157.71%; fume emissions also dropped from 10.95 million tons in 2004 to 7.96 million tons in 2020. Figure 4 shows the change trajectories of SO_2 emissions and FDI in China from 2004 to 2020. During these 16 years, the degree of environmental pollution had decreased, while FDI had constantly increased, but whether there is a correlation between the two is still pending for subsequent research and analysis. Meanwhile, besides FDI, other social and economic factors might affect the environmental pollution status as well; in view of this, they will be discussed further in the fifth chapter of this study.

4. Empirical Analysis

4.1. Data Source and Sample Selection. The relevant data used in this research were quoted from the *China Statistical Yearbook*. The independent variable pollutant emissions include a few aspects such as air pollution, water pollution, waste pollution, sound pollution, and eco-environment damage. For the problem of how to use a single indicator to well describe the overall damage level of the environment and resources in a country or in a region, existing studies have not given a satisfactory answer yet. Therefore, existing studies mostly used multiple specific pollution indicators. Although China has been constantly adjusting and optimizing its energy structure in recent years and the coal consumption speed has slowed down obviously, still coal accounts for more than 50.00% of China's primary energy consumption, and the burning of the sulfur-containing fuels (mainly the coal) is a major source of pollutant SO_2. Although CO_2 can aggravate the greenhouse effect, causing temperature rise, sea level rise, and other phenomena, CO_2 is not an air pollutant and the damage caused by it to the environment is not regarded as pollution. This study also chose SO_2 as the indicator to describe the environmental pollution level in the estimation of the basic model; moreover, in this study, the total investment of foreign-invested enterprises was used to represent the amount of FDI invested by country i to China within time period t; its unit was one billion dollars; and GDP was used to represent the economic scale. In addition, the number of patent applications refers to the quantity of patent applications received by patent institutions applying for the grant of patents of technical inventions; it is the sum of invention patent applications, utility model patent applications, and design patent applications; and this indicator can reflect the activity degree of technological development and the initiative level of inventors to apply for patent protection. The more the number of patent applications, the higher the innovation capability of a society, and the more dynamic the society is; in this study, the number of patent applications is used to describe the regional technological level based on two considerations: first, the number of patent applications can reflect the competitiveness and innovativeness of a region and whether technological development activities are active or not, and the more the number of patent applications, the strong the innovation ability of the region; second, the number of patent applications can also reflect the technology update status of a region, the changes in the number of patent applications can indicate the technology update cycle, and the greater the increment of the number of patent applications, the faster the technology innovation in the region, the faster the technology update, and the more obvious the technological advancement in the region. Thus, this study chose to use this indicator to represent the technological level of the regions.

In addition, this study also quoted data from the Statistical Yearbooks of provinces, municipalities, and autonomous regions of China. In a country, when the focus of its economic development or industrial structure has gradually shifted from the primary industry to the secondary and tertiary industry, it can be considered that the country's industrial structure is being optimized, so this study chose to use the total output of the tertiary industry to represent the industrial structure of the region (Table 1).

In specific analysis, considering the stability of the variables, this study performed logarithmic difference processing on the abovementioned variables, and all variables mentioned in the following texts are variables after being subjected to logarithmic difference processing. Subsequently, the indicator data were sorted and the panel data of 31 Chinese provinces, municipalities, and autonomous regions (this study had only analyzed the mainland areas of China) from 2006 to 2019 were listed in the samples. All data were from the China Statistical Yearbook and the Statistical Yearbooks of 31 provinces, municipalities, and autonomous regions of China; and the selected variables, which involved nominal value data had all been converted into US dollars (in 2006 constant price).

Note that indicator SO_2 refers to the SO_2 emissions of each province, municipality, and autonomous region, units in 10,000 tons. Indicator gdp refers to the gross domestic product of each province, municipality, and autonomous region, units in billions of dollars. Indicator thi refers to the gross domestic product of the tertiary industry of each province, municipality, and autonomous region, units in billions of dollars. Indicator teca refers to the number of patent applications of each province, municipality, and autonomous region. Indicator fdi refers to the total investment of foreign-invested enterprises of each province, municipality, and autonomous region, units in billions of dollars. All nominal values were converted into US dollars (in 2006 constant price).

4.2. Benchmark Analysis. To a certain extent, the increase in FDI has a direct impact on pollutant emissions, and at the same time, it also has an indirect impact on it through the mechanisms of scale effect, structural effect, and technological effect. So in this study, the three variables of scale, structure, and technology had been included in the analysis. Based on the Copeland-Taylor model [2], this study introduced the technological factor and constructed an environmental pollution model containing multiple influencing factors.

The PVAR (panel vector autoregression) model proposed by Holtz-Eakin et al. can analyze the interaction between endogenous variables of panel data, and it regards all variables as endogenous variables to analyze each variable and its relationship with the lag term. Compared with the

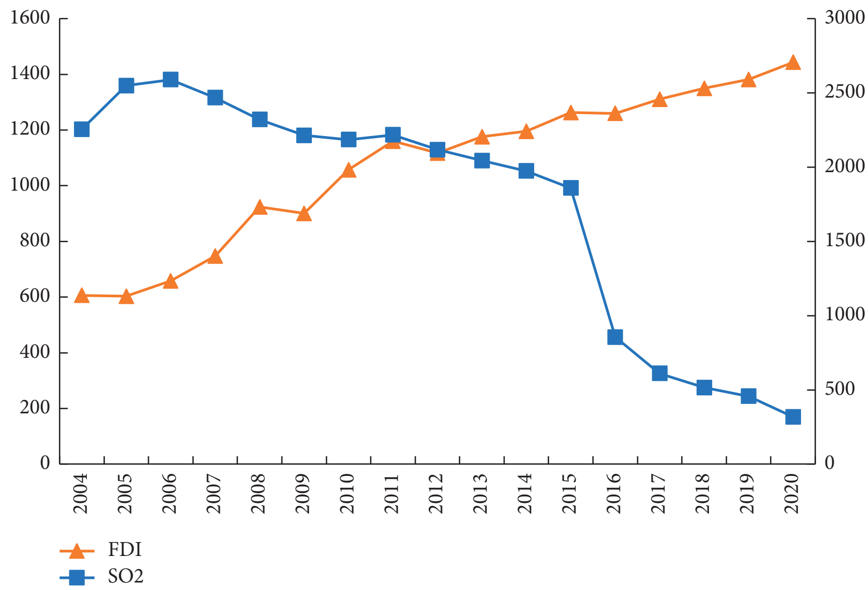

FIGURE 4: Changes in SO_2 emissions and FDI in China (2004–2020). Note: the axis on the left is the total SO_2 emissions of 31 provincial administrative regions in mainland China from 2004 to 2020, and the unit is 10,000 tons; the axis on the right is the total amount of FDI of the 31 provincial administrative regions in mainland China from 2004 to 2020, and the unit is 1 billion US dollars. The FDI values here are the total investment data of foreign-invested enterprises, and all data were quoted from the China Statistical Yearbook.

TABLE 1: Descriptive statistics of main variables.

Variable	Obs	Mean	Std. dev.	Min	Max
dlnso2	403	−0.0693	0.1857	−1.0838	0.4790
dlngdp	403	0.0909	0.0450	−0.2643	0.2118
dlnthi	403	0.1076	0.0384	−1.4889	0.2972
dlnteca	403	0.2215	0.1568	−0.3461	0.9888
dlnfdi	403	0.0795	0.1952	−1.2804	1.8773

long time-series requirements of the conventional VAR models, the PVAR model has the features of large cross section and shorter time series, and it can use panel data to effectively solve the problem of individual heterogeneity, and fully consider the individual effect and time effect. Therefore, in this research on FDI and environmental pollution, this model had been taken as the basis, and other important influencing factors of environmental pollution such as economic scale, industrial structure, and technical factors were introduced to fully consider the differences in the effect under different action mechanisms. In the empirical analysis, the PVAR model treated all variables as endogenous variables. Combining with the commonly used PVAR models and the research objectives of this study, the proposed model was set as follows:

$$
\begin{aligned}
Z_{i,t} &= \alpha_0 + \alpha_1 \sum_{j=1}^{k} \rho_j Z_{i,t-j} + \mu_i + \gamma_t + \varepsilon 1_{i,t},\\
Y_{i,t} &= \beta_0 + \beta_1 \sum_{m=1}^{p} \beta_m Y_{i,t-m} + \varphi_i + \omega_t + \varepsilon 2_{i,t},\\
Q_{i,t} &= \varphi_0 + \varphi_1 \sum_{n=1}^{u} \tau_n Q_{i,t-n} + \sigma_i + \theta_t + \varepsilon 3_{i,t},
\end{aligned} \tag{1}
$$

where $Z_{i,t}$, $Y_{i,t}$, and $Q_{i,t}$ are column vectors containing 3 endogenous variables; i and t represent the country and the year; α_0, β_0, and φ_0 are intercept term vectors; ρ_j, β_m, and τ_n represent regression coefficient matrixes, wherein j, m, and n represent the lag orders of each variable; μ_i, φ_i, and, σ_i represent individual effects; γ_t, ω_t, and θ_t represent time effects; and $0\varepsilon 1_{i,t}$, $\varepsilon 2_{i,t}$, and $\varepsilon 3_{i,t}$ are random disturbance terms. Model (1) represents the dynamic relationship among FDI, economic scale, and environmental pollution. Model (2) represents the dynamic relationship among FDI, industrial structure, and environmental pollution. Model (3) represents the dynamic relationship among FDI, production technology, and environmental pollution.

The PVAR model proposed in this study gave estimations by referring to the methods of Love and Zicchino [19] and Abrigo and Love [20]. In order to avoid the problem of spurious regression, this study applied the LLC and IPS criteria to test the stability of each variable. The test results are shown in Table 2. Both LLC and IPS tests rejected the original hypothesis that there are unit roots at the 1% significant level, so the variables were all stable sequences.

In the optimal lag-order test of the model, the optimal lag sequence of the model was determined according to three information criteria of MBIC, MAIC, and MQIC, as shown in Table 3, and the results showed that the lag-order values of Model (1) and Model (2) should be 1, that is, the optimal lag order of the two models should be 1, and the optimal lag order of Model (3) should be 2. Therefore, when estimating Model (1) and Model (2), this study chose 1 as the lag order; and when estimating Model (3), this study chose 2 as the lag order. With the help of software Stata 15, the estimation results of the PVAR model were attained, details as shown in Table 4.

Table 2: Variable stability tests.

Variable	LLC statistic	IPS statistic	Test results
dlnso2	−14.1708***	−8.4215***	Stable
dlngdp	−8.1533***	−3.0101***	Stable
dlnthi	−11.8877***	−4.9922***	Stable
dlnteca	−11.1723***	−6.2058***	Stable
dlnfdi	−12.2733***	−6.3312***	Stable

Note. The LLC statistic column is the statistics of bias compensation t_δ, * (adjusted t^*), and the IPS statistic column is the statistics of $w_{\bar{t}}$. ***, **, and *, respectively, represent the significance levels of 1%, 5%, and 10%.

According to the results of Model (1) and the equation of environmental pollution, we can know that the estimation coefficient of economic scale of the period one-phase behind (the period that has lagged behind the current period for one phase) was significantly positive at the 1% significance level, and the value 2.68 was relatively large, indicating that the expansion of economic scale had a significant promotive effect on the deterioration of environmental pollution; when the economic scale increased by 1.00%, the environmental pollution level would increase by 2.68%; the estimation coefficient of FDI of the period one-phase behind was negative, but not significant, indicating that the adverse impact of DFI on the environment was decreasing, but its inhibitory effect on environmental pollution had not shown yet, and there is only a certain tendency of environmental improvement. In terms of the equation of economic scale, the environmental pollution variable of the period one-phase behind had a significant positive impact on the economic scale of the current period, indicating that, on the whole, the economy of China mainland areas was developing at the cost of environmental pollution; the economic scale of the period one-phase behind had a significant positive impact on the economic scale of the current period. The lag term of FDI was not significant, which indicated that FDI did not necessarily promote the expansion of economic scale. According to the regression results of the equation of FDI, the economic scale variable of the period one-phase behind had a significant negative impact on the FDI of the current period, that is, when the economy has developed to a certain level, the growth rate of FDI invested by foreign-invested enterprises into a region would slow down, while regions with less-developed economic level would attract more foreign capitals, and the growth of investment would be faster.

According to the results of Model (2) and the equation of environmental pollution, the estimation coefficient of the lag term of the industrial structure was significantly positive at the 1% significance level, so the higher the total output of the tertiary industry, the faster the growth rate, and the higher damage level of the environment. The mechanism behind it was that, although the damage brought by the tertiary industry to the environment was weaker compared with that brought by industrial pollution, still the development of tertiary industries such as commerce, catering, and entertainment had brought a great amount of "white pollution," and the burning of nondegradable plastics had produced harmful gases and polluted the atmosphere. In addition, the rapid development of the transportation industry has also put pressure on the improvement of environmental conditions. In terms of the equation of industrial structure, the estimation coefficient of the industrial structure variable of the period one-phase behind was significantly positive, indicating that the upgrading of the industrial structure is an ever-growing process; for regions with better industrial structure, their tertiary industry grew faster; while for those with worse industrial structure, their tertiary industry faced more difficulties during industrial structure optimization and upgrading. In terms of the equation of FDI, the estimation coefficient of the lag term of the industrial structure was significantly negative at the 1% significance level, indicating that for regions with more advanced tertiary industry and better industrial structure, their FDI grew slower, and the possible reason was that the FDI had mainly gone to the secondary industry.

Table 3: PVAR lag-order test results.

		PVAR (1)	PVAR (2)	PVAR (3)	PVAR (4)
Model (1)	MBIC	−142.3318*	−107.0167	−67.5340	−33.3060
	MAIC	−20.6555*	−15.7595	−6.6959	−2.8870
	MQIC	−69.8076*	−52.6236	−31.2720	−15.1750
Model (2)	MBIC	−147.9034*	−120.8728	−73.2340	−34.5923
	MAIC	−26.2271	−29.6156*	−12.3959	−4.1733
	MQIC	−75.3793*	−66.4797	−36.9720	−16.4613
Model (3)	MBIC	−121.1774*	−111.2331	−72.9278	−40.4811
	MAIC	−6.1366	−19.9759*	−12.0897	−10.0620
	MQIC	−55.2888	−56.8401*	−36.6658	−22.3501

The symbols ***, **, and *, respectively, represent the significance levels of 1%, 5%, and 10%.

According to the results of Model (3), in terms of the equation of environmental pollution, both the first-order lag term and the second-order lag term of the technological level were significantly positive, and the coefficient values are relatively small, indicating that the improvement of production technology had exerted a negative impact on the environment, which might be because that the improvement of production technology was mainly concentrated in the industrial production field, which took production scale expansion and production efficiency improvement as targets, not concentrated in the high-tech industries. In terms of the equation of technological level, both the first-order lag term and the second-order lag term of the technological level were significantly positive, indicating that the improvement of the technological level is also a continuously growing process. For regions with stronger innovation capability and more active R&D activities, their technological level grew faster; while for regions with weaker innovation capability, their technological level grew slower. Similarly, according to the equation of FDI, the estimation coefficient of the environmental pollution variable of the period one-phase behind was significantly negative.

4.3. Impulse Response. In this study, Monte Carlo simulations were repeated for 500 times to get a graph of the impulse response function of the period ten-phase behind and generate a 95% confidence interval at the same time.

By analyzing the impulse response as shown in Figure 5, we can see that (1) if the economic scale is impacted by an

Table 4: PVAR estimation results.

Model (1)	dlnso2		dlngdp		dlnfdi	
	b_GMM	t_GMM	b_GMM	t_GMM	b_GMM	t_GMM
L.dlnso2	0.0258	0.5039	0.0344***	4.7770	0.0815	1.0985
L.dlngdp	2.6820***	7.9849	0.6945***	14.8260	−1.9432***	−5.0698
L.dlnfdi	−0.0255	−0.5424	0.0110	1.3418	0.0375	04352
Model (2)	*dlnso2*		*dlnthi*		*dlnfdi*	
	b_GMM	t_GMM	b_GMM	t_GMM	b_GMM	t_GMM
L.dlnso2	0.2007***	4.7795	0.0298***	3.9626	−0.0687	−1.1355
L.dlnthi	2.9442***	5.7806	0.4136***	5.1031	−2.3588***	−5.0431
L.dlnfdi	−0.0768	−1.4239	−0.0015	−0.1565	0.0881	1.1943
Model (3)	*dlnso2*		*dlnteca*		*dlnfdi*	
	b_GMM	t_GMM	b_GMM	t_GMM	b_GMM	t_GMM
L.dlnso2	0.2229***	2.9520	0.0217	0.2899	−0.2707***	−3.4658
L.dlnteca	0.5627**	2.3120	0.7574***	3.6170	−0.0898	−0.4078
L.dlnfdi	−0.0610	−0.8188	0.1233	1.4634	0.1448	1.4671
L2.dlnso2	0.0629	0.5735	−0.2045**	−2.3196	−0.1658	−1.5512
L2.dlnteca	0.7623***	4.0316	0.4195***	2.7675	−0.0640	−0.3194
L2.dlnfdi	−0.0296	−0.6545	0.0294	0.4383	−0.0175	−0.3895

Note. L. represents lagging for one phase; b_GMM represents the estimation coefficient; and t_GMM represents the *t*-value. ***, **, and *, respectively, represent the significance levels of 1%, 5%, and 10%.

impulse with the size of a standard deviation, the environmental pollution would give a strong positive response. In the figure, such response reached the maximum at the end of the first period and then gradually decreased, but this impact existed for a long time and remained at the 0.01 level until the end of the seventh period. This means that the expansion of the economic scale had a long-term promotive impact on environmental degradation, as shown in Figure 5; if the economic scale is impacted by a standard deviation, there will be a significant positive response in environmental pollution; and this impact will last for a long time. Moreover, Figure 5 also reflects that FDI will give a negative response under the impact of economic scale. The expansion of the economic scale will lead to a decrease in the growth rate of FDI, thereby weakening the positive impact of FDI on the economic scale; then, the growth rate of FDI will decline; and the environmental condition will be improved accordingly. FDI showed a negative response, which reached -0.06 at the end of the first period and then gradually declined, indicating that the expansion of the economic scale had a negative impact on the growth rate of FDI. (2) If the environmental pollution variable is impacted by an impulse with the size of a standard deviation, the economic scale would give a positive response. In the figure, this response reached the maximum at the end of the first period and then gradually decreased, which was mainly because that regions that are at the initial and middle stage of industrialization would tend to sacrifice their environment to promote economic development; FDI fluctuated a bit within a short time; it responded negatively at first and positively later; and then, it responded negatively and approached 0 continuously, indicating that the response of FDI to changes in environmental pollution was not stable, and it might be influenced by regional development conditions or other economic factors. (3) If FDI is impacted by an impulse with the size of a standard deviation, the environmental pollution variable would give a negative response within a short time; then, the response became positive and gradually approached 0; this shows that FDI had a short-term inhibitory effect on environmental pollution; but in the long run, such effect did not last for a long time; since the zero line remained within the confidence interval all this time, so the economic scale did not have a significant response, there is only a small response in the first period; then, the response gradually decreased and started to approach 0, which was because although FDI had directly expanded the domestic investment scale and promoted economic development via using capital to drive GDP growth, but the economic scale effect of FDI was affected by various factors such as industrial structure, population size, production technology, and sectoral and regional differences, so it is necessary for each region to formulate reasonable plans for FDI and maximize its outcomes.

By analyzing the impulse response shown in Figure 6, we can see that (1) if the industrial structure is impacted by an impulse with the size of a standard deviation, the environmental pollution would give a positive response. In the figure, such response reached the maximum at the end of the first period and then gradually decreased, but its value remained at the 0.01 level by the end of the seventh period, indicating that the growth of the total output of the tertiary industry in each region might be driven by the development of high-polluting industries such as transportation and catering, while the low-polluting high-tech industries and modern service industries such as financial sector, commercial services, and cultural industry only took a small proportion; FDI exhibited a long-term and lasting negative response, which means that for regions with the faster growth rate of tertiary industry and better industrial structure, their FDI grew slower. (2) If the environmental pollution is impacted by an impulse with the size of a standard deviation, the industrial structure would give a positive response, so it can be seen that the environmental pollution can trigger a positive change in the industrial

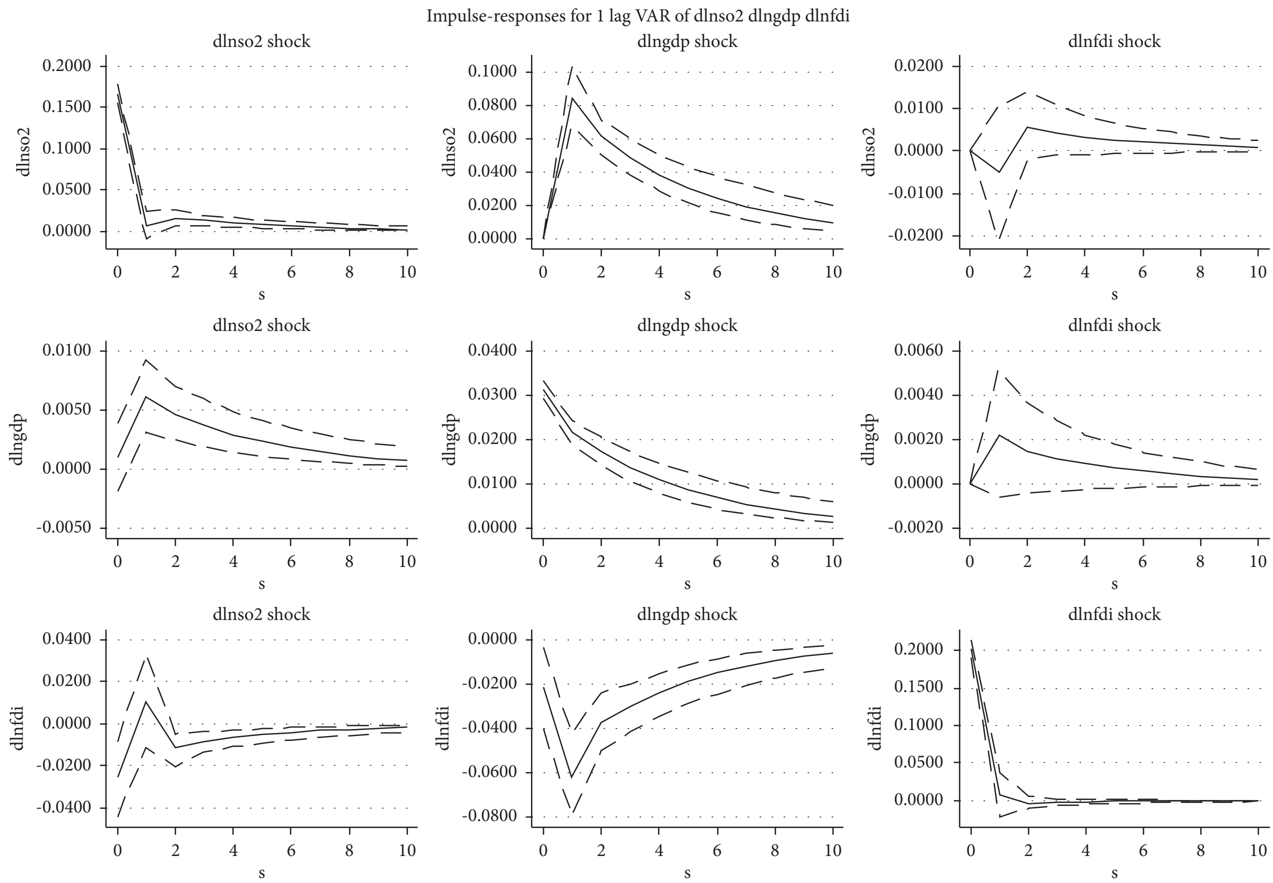

Figure 5: Impulse response of Model (1).

structure within a short time, but in the long run, such impact would approach 0; when the impact came, FDI showed a negative response, that is, when the environmental conditions in a region deteriorate, the country from which the FDI flowed out would tend to reduce its investment in a short time. (3) If the FDI is impacted by an impulse with the size of a standard deviation, environmental pollution and industrial structure would give a negative response, which means that the increase in FDI was not conducive to the optimization of industrial structure, but it had promoted the improvement of environmental conditions to a certain extent.

By analyzing the impulse response shown in Figure 7, we can see that (1) for the impact on the technological level, the environmental pollution gave a positive response. Since the improvement of production technology was mainly concentrated in the industrial production field, which took production scale expansion and production efficiency improvement as targets, it further aggravated the environmental pollution. For any technology, it would require a transition period from the invention stage to the application in the actual production field, so the response of environmental pollution to the technological level reached the maximum between the fourth and the sixth periods; FDI exhibited a negative response; and similarly, its response value reached the maximum between the fourth and the sixth periods. China's labor costs are relatively low, so the local governments had formulated a series of preferential policies to attract foreign capitals. Since foreign capitals generally aim to reduce production costs, they tend to go to less-developed regions with low technological level and labor costs; while in regions with a higher technological level, the growth rate of foreign investment was lower and even became negative. (2) For the impact on environmental pollution, both the technological level variable and the FDI variable showed an alternating positive and negative response. (3) As for the impact on FDI, the environmental pollution variable gave a positive response, whose value reached the maximum in the sixth period; since the zero line was within the confidence interval all the time, the production technology did not give a significant response, and the change in this response value was relatively gentle and continued. On the whole, for most regions in China, FDI mostly has gone to labor-intensive processing and trade industries with a low technological level. In terms of the structure of the introduced technology, the introduced technologies are mostly primary-level technologies, and the foreign investment only had a limited promotive effect on the technological level.

4.4. Variance Decomposition. The variance decomposition can clearly reflect the degree to which each variable explains itself in each period. The results of the variance decomposition are listed in Tables 5-7.

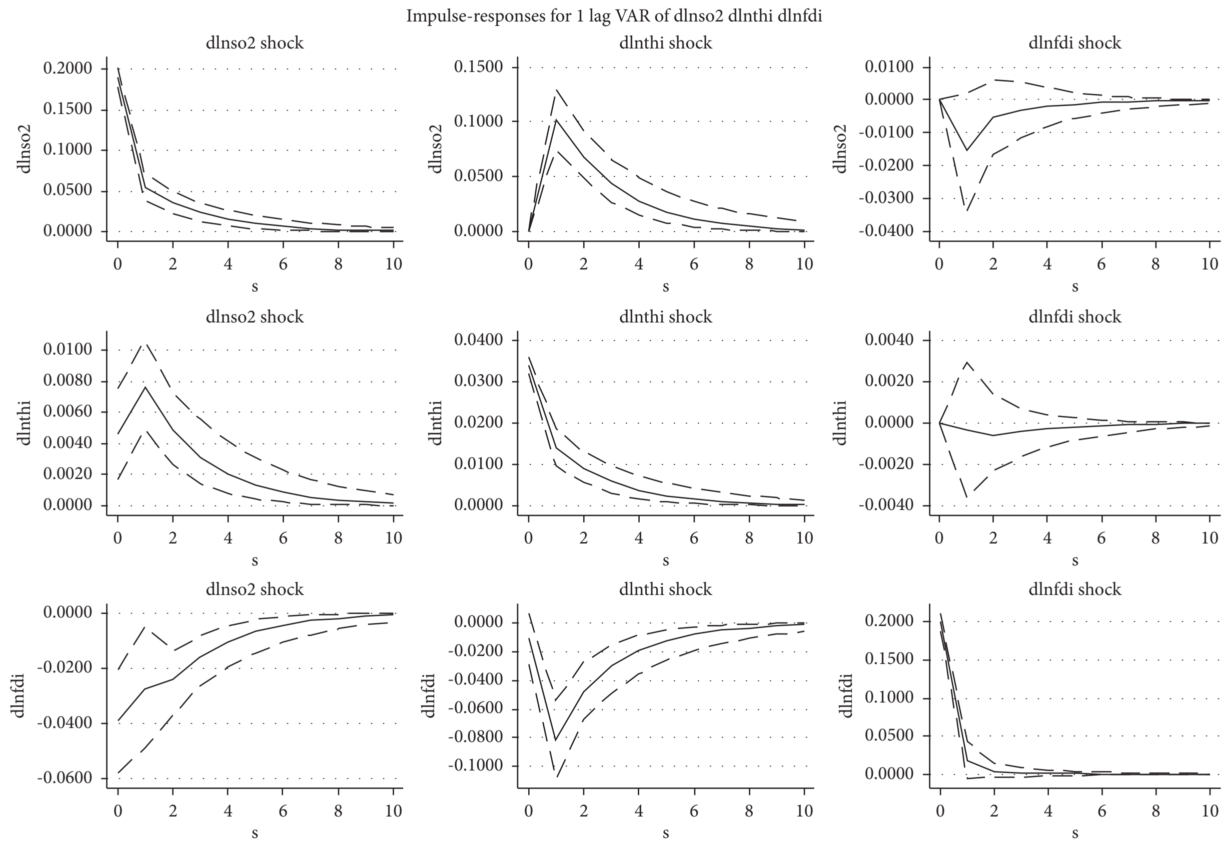

Figure 6: Impulse response of Model (2).

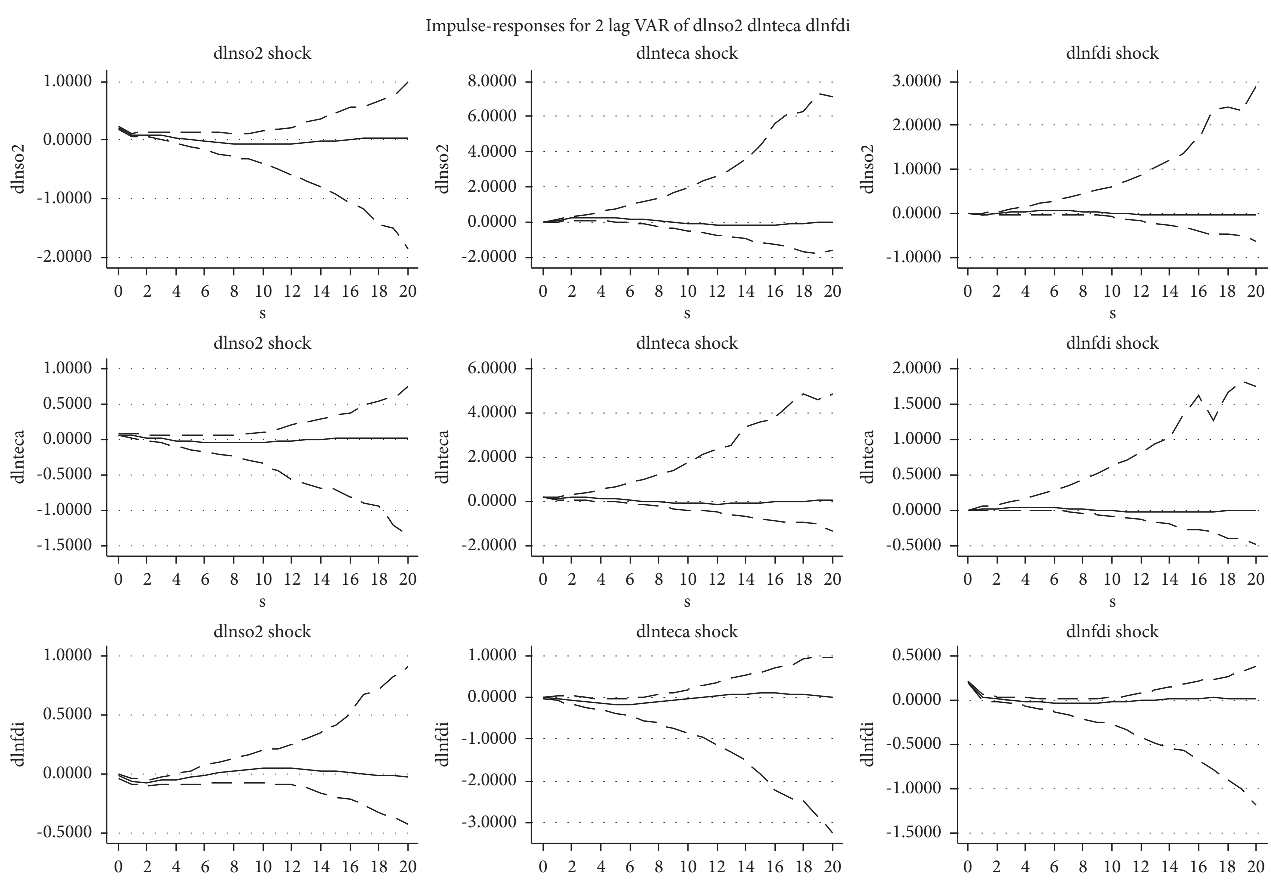

Figure 7: Impulse response of Model (3).

According to the variance contribution rate shown in Table 5, besides the influence of each variable on itself, the economic scale had a strong ability in explaining environmental pollution, and the variance contribution rate tended to be stable around the fifth period and finally stabilized at about 37.53%. Correspondingly, environmental pollution also had a good ability in explaining the fluctuations in the economic scale, and the variance contribution rate reached 3.87% in the fifth period and still showed a gradual upward trend. This indicates that, for the current development status of China, there is a long-lasting correlation between economic growth and environmental deterioration. FDI only had a weak ability in explaining the fluctuations in environmental pollution, and the values of the variance contribution rate between the third and fifth periods were kept under 0.20%. Same as the previous analysis results, the impact of FDI on the environment was not obvious. The ability of FDI in explaining the economic scale remained below 0.40% for a long time, indicating that the various regions in China had not made good use of the foreign capital properly, and the effect of FDI in promoting economic growth had not been fully exerted.

According to the variance contribution rate shown in Table 6, besides the influence of each variable on itself, the variance contribution rate of industrial structure to environmental pollution fluctuations showed an upward trend; its explanation ability was relatively good; and the value reached 30.46% in the tenth period. The variance contribution rate of environmental pollution to the fluctuations of industrial structure also remained at a level of 7.36%, indicating that the transportation and the catering industries occupied a large proportion in the output of the tertiary industry in China; their impact on environmental deterioration was obvious, and such impact would last for a long time. Likewise, FDI had a weak ability in explaining the environmental pollution variable, and the variance contribution rate of the industrial structure variable to FDI gradually increased, reaching 19.41% in the tenth period. There is a strong correlation between the growth rate of FDI of a region and its industrial structure.

According to the variance contribution rate shown in Table 7, besides the influence of each variable on itself, the variance contribution rate of the environmental pollution variable to the technological level had gradually decreased, but it showed an upward trend after the fifth period. The variance contribution rate of technological level to environmental pollutant fluctuations gradually increased, reaching 9.34% in the tenth period. The improvement of the technological level was mainly concentrated in the field of industrial production, so it is closely related to the fluctuations of environmental pollution. On the other hand, the variance contribution rate of technology level to FDI rapidly increased after the third period, reaching 38.99% in the fifth period, and then reaching 66.03% in the tenth period, indicating that the technological level only had a small impact on the introduction of foreign capital within a short time, but in the long run, the technological level had a very strong ability in explaining the scale and growth rate of foreign investment.

Table 5: The PVAR variance decomposition results of Model (1).

	s	dlnso2	dlngdp	dlnfdi
dlnso2	1	1.00000	0.00000	0.00000
	3	0.71710	0.28141	0.00149
	5	0.65422	0.34379	0.00199
	10	0.62244	0.37532	0.00224
dlngdp	1	0.00107	0.99893	0.00000
	3	0.03347	0.96266	0.00386
	5	0.03866	0.95707	0.00427
	10	0.04104	0.95449	0.00446
dlnfdi	1	0.01503	0.01080	0.97417
	3	0.01819	0.11956	0.86225
	5	0.01979	0.14540	0.83482
	10	0.02067	0.15993	0.81939

Table 6: The PVAR variance decomposition results of Model (2).

	s	dlnso2	dlnthi	dlnfdi
dlnso2	1	1.00000	0.00000	0.00000
	3	0.72659	0.26863	0.00478
	5	0.69651	0.29875	0.00473
	10	0.69073	0.30455	0.00472
dlnthi	1	0.01789	0.98211	0.00000
	3	0.06633	0.93337	0.0003
	5	0.07219	0.92736	0.00044
	10	0.07335	0.92618	0.00047
dlnfdi	1	0.03672	0.00266	0.96062
	3	0.05480	0.17190	0.77329
	5	0.05981	0.19080	0.74981
	10	0.06081	0.19406	0.74513

Table 7: The PVAR variance decomposition results of Model (3).

	s	dlnso2	dlnteca	dlnfdi
dlnso2	1	1.00000	0.00000	0.00000
	3	0.48857	0.51011	0.00132
	5	0.24917	0.73684	0.01399
	10	0.17006	0.78892	0.04101
dlnteca	1	0.13778	0.86222	0.00000
	3	0.09486	0.88921	0.01593
	5	0.06194	0.90732	0.03074
	10	0.09342	0.86268	0.04389
dlnfdi	1	0.00932	0.00021	0.99047
	3	0.19367	0.05311	0.75322
	5	0.17213	0.38982	0.43805
	10	0.09728	0.66030	0.24242

4.5. Analysis of Regional Heterogeneity. The Seventh Five-Year Plan formulated by the Chinese government in 1986 divided the mainland areas of China into three major regions: the eastern region, the central region, and the western region. In 1997, Chongqing was established as a municipality and included in the western region. Then, in 2000, the policies and measures concerning large-scale development of the western region granted the Inner Mongolia Autonomous Region and the Guangxi Zhuang Autonomous Region with the same preferential policies. After these adjustments, now the western region includes 12 provincial-level administrative regions; the central region includes 8 provincial-level administrative regions; and the eastern region includes 11 provincial-level administrative regions. Regarding economic development level, the eastern region's economy is the most developed, its industrial structure is better, and the basic facilities are relatively complete; the central region develops fast in recent years, but the overall development degree is lower than that of the eastern region; the western region enjoys more policy support, but compared with the eastern region and the central region, its economic development level is lower. Since the three mechanism variables of eastern, central, and western regions had all shown obvious features of step development, the regional division can fully reflect whether the differences in the size of mechanism variables have different impacts on the three action paths.

This study conducted an empirical analysis on the dynamic impact of FDI, environmental pollution, and three action mechanisms on each region. The stability test was performed first; then, according to the results of the optimal lag order obtained by the PVAR model, first-order lag had been selected for the three regions under the three action mechanisms (Table 8).

According to the estimation results of Model (1), no matter for the eastern region, central region, or the western region, the GDP of first-order lag had a significant positive promotive effect on the environmental pollution variable. The environmental pollution effect of the economic scale of the eastern region was the strongest, followed by the central region, and the western region was the weakest. For the three regions, all coefficients of the impact of first-order lag GDP were all negative; but in terms of the absolute values of the coefficients, the impact of the eastern region's economic scale on FDI was greater than that of the central region; and the impact of the central region's economic scale on FDI was greater than that of the western region. Just the same as the conclusion obtained from the previous analysis, when the economy has developed to a certain scale, the growth rate of foreign capitals attracted by a region would decrease. Although for the eastern and central regions, the effect of the environmental pollution variable of first-order lag on GDP was positive, it was not significant, and the coefficient was small, indicating that as the economic development of eastern and central regions was transforming and upgrading, the contribution of high-polluting industries to economic development decreased, while for the western region, the expansion of its economic scale was still at the expense of environmental pollution.

According to the estimation results of Model (2), in terms of the coefficient of the impact of industrial structure variable of first-order lag on environmental pollution, the coefficients of all three regions were positive, but the coefficients of the eastern region and the central region were higher, and the coefficient of the western region was lower. China's high-tech industries are mainly distributed in the eastern region, namely, the developed coastal areas of three major economic circles: the Pearl River Delta, the Yangtze River Delta, and the Beijing-Tianjin-Hebei Bohai economic circle. However, the high-tech industries in China are still at the initial stage of development, and manufacturing industries such as electronic and communication equipment manufacturing, electronic machinery and equipment manufacturing, and transportation equipment manufacturing are still taking up the most important position in the industrial layout. As the upgrading of industrial structure in the eastern region is accelerating, the central and western regions have undertaken the industries that are transferred out from the eastern region. In the central region, the infrastructure is relatively complete; the labor resource is sufficient; and it has some advantages in taking in the transferred industries. However, in the western region, the dominant industries of some provinces are generally the tourism industry and the agriculture and animal husbandry industries with local features; in addition, in recent years, these provinces have initiated the project of marginal farmland afforestation and strengthened eco-environment protection and construction; and the environmental pollution effect of the industrial development of the western region is relatively weak. In terms of the coefficient of the impact of FDI of first-order lag on industrial structure, the FDI of the eastern and western regions had not shown a significant promotive effect on the development of the tertiary industry; while for the central region, although the impact of FDI on its industrial structure was not significant, it had shown a negative trend. The coefficients of the impact of industrial structure variable of first-order lag of the three regions were all negative, and there is a common phenomenon in the various regions of China, that is, FDI tends to flow into regions with less-developed tertiary industry and slower growth rate, indicating that the FDI entering China generally pays more attention to the labor force or other cost advantages, since the purpose of foreign investment is to reduce production costs, so it will prefer regions with less-optimized industrial structure.

According to the estimation results of Model (3), in terms of the coefficient of the impact of the technological-level variable of first-order lag on environmental pollution, the coefficients of the three regions were all significantly positive, wherein the coefficient of the central region was the largest, indicating that compared with eastern and western regions, the improvement of the technological level of the central region was mainly in the industrial production field; therefore, the pressure on the environment was higher. The FDI of first-order lag of the eastern region had a significant positive impact on the environmental pollution variable, and this is also in line with previous analysis. A considerable part of the FDI flowing into the eastern region had promoted the development of the low-polluting tertiary industry, exerting an effect of environmental improvement. The coefficients of the impact of the technological-level variable of one-order lag were all significantly negative, indicating that the foreign investment attracted by regions with a high technological level was less. At present, the FDI attracted to China is mainly low-end production, and the investment in technology R&D cooperation is few.

Table 8: The PVAR estimation results of each region.

	Eastern region			Central region			Western region		
Model (1)	*dlnso2*	*dlngdp*	*dlnfdi*	*dlnso2*	*dlngdp*	*dlnfdi*	*dlnso2*	*dlngdp*	*dlnfdi*
L.dlnso2	−0.5930	−0.0003	0.4491**	0.0432	0.0160	0.2894*	0.1707***	0.0571***	−0.0587
L.dlngdp	5.6114***	0.6780***	−3.2730***	3.1288***	0.7975***	−3.2410***	1.7628***	0.7498***	−1.6985**
L.dlnfdi	0.0181	0.0073	0.1048	0.0201	0.0302	−0.3343	−0.0340	0.0134	−0.0005
Model (2)	*dlnso2*	*dlnthi*	*dlnfdi*	*dlnso2*	*dlnthi*	*dlnfdi*	*dlnso2*	*dlnthi*	*dlnfdi*
L.dlnso2	−0.0133	0.0347**	0.0908	0.3900***	0.0183*	−0.1264	0.2022***	0.0274*	−0.1178
L.dlnthi	4.6449***	0.3833**	−2.8989***	3.1628**	0.0955	−3.5888***	1.9660***	0.5624***	−2.1643***
L.dlnfdi	−0.0652	0.0029	0.1585	−0.1878	−0.0212	−0.0693	−0.0351	0.0089	0.0340
Model (3)	*dlnso2*	*dlnteca*	*dlnfdi*	*dlnso2*	*dlnteca*	*dlnfdi*	*dlnso2*	*dlnteca*	*dlnfdi*
L.dlnso2	0.2372***	0.1389**	−0.0548	0.2598***	0.0578	0.0127	0.0574	−0.1638	0.0415
L.dlnteca	0.5916***	0.3234***	−0.3606***	0.8488**	0.5204***	−0.9794***	0.5637**	0.3455	−0.6218*
L.dlnfdi	−0.0771	0.0511	0.1639	0.0403	0.0941	−0.3228	0.0866	0.1267	−0.0997

The symbols ***, **, and *, respectively, represent the significance levels of 1%, 5%, and 10%.

Table 9: Estimation results of the robustness test.

	(1)			(2)		
Model (1)	*dlnso2*	*dlngdp*	*dlnfdi*	*dlnso2*	*dlngdp*	*dlnfdi*
L.dlnso2	0.0300	0.0338***	0.0785	0.7114	0.0386***	0.0551
L.dlngdp	2.6562***	0.7081***	−1.9639***	2.6483***	0.7083***	−2.0305***
L.dlnfdi	−0.0267	0.0124	0.0342	−0.0758	0.0196	−0.0077
Model (2)	*dlnso2*	*dlnthi*	*dlnfdi*	*dlnso2*	*dlnthi*	*dlnfdi*
L.dlnso2	0.1996***	0.0290***	−0.0731	0.2499***	0.0343***	−0.1086**
L.dlnthi	2.9918***	0.4086***	−2.4818***	2.6961***	0.3955***	−2.2372***
L.dlnfdi	−0.0711	−0.0009	0.0807	−0.1833**	−0.0054	0.1048
Model (3)	*dlnso2*	*dlnteca*	*dlnfdi*	*dlnso2*	*dlnteca*	*dlnfdi*
L.dlnso2	0.2446***	0.0249	−0.2695***	0.2427***	0.0507	−0.2655***
L.dlnteca	0.5498**	0.7548***	−0.1110	0.5059	0.9040***	−0.0557
L.dlnfdi	−0.0733	0.1192	0.1395	−0.0818	0.2711	0.1682
L2.dlnso2	−0.0395***	−0.2043**	−0.1638	−0.0460	−0.2105*	−0.1687*
L2.dlnteca	0.7563	0.4152***	−0.0751	0.7292***	0.5061**	−0.0350
L2.dlnfdi	−0.0369	0.0271	0.0167	−0.0201	0.1250	0.0332

The symbols ***, **, and *, respectively, represent the significance levels of 1%, 5%, and 10%.

4.6. Robustness Test. In the comparison of the average values of FDI and SO_2 emissions of each provincial administrative region during 2007 and 2020, it is found that Jiangsu province has the largest amount of FDI introduction, and Shandong province has the largest amount of SO_2 emissions. Therefore, the maximum value is removed for analysis to explore whether the above analysis results effectively exclude outliers. Beijing is the capital city of China. In recent years, the government of Beijing has constantly promoted industrial upgrading and structural adjustment in the city and removed its noncapital functions through the means of removing, transferring, and upgrading. According to the catalogue of prohibitions and restrictions on new industries, Beijing has shut down all high-polluting, high energy consumption, and high water consumption enterprises. Labor-intensive and resource-dependent traditional manufacturing enterprises that do not conform to the strategic positioning of Beijing as the capital city have been relocated. Manufacturing links with less advantage in high-end industries have been adjusted. In 2013, the average annual concentration of SO_2 in Beijing was 27 $\mu g/m^3$, which continuously decreased ever since and became single digits after 2017; in 2021, the concentration further decreased until an extremely low level of 3 $\mu g/m^3$, and compared with 2013, the SO_2 concentration had decreased by 88.7%. Therefore, according to the actual data, Beijing's environmental pollution is not an extreme case in the whole country, so we had only excluded the extreme data. Column (1) of Table 9 is the estimated result after removing two individuals from Jiangsu and Shandong provinces. In order to better exclude the interference of outliers on the results, we abbreviated the continuous variables at the 1% level in column (2). The results had all passed the stability test, and the values of the optimal lag order of the PVAR model were still 1-order, 1-order, and 2-order. Judging from the estimation results of the robustness test, after abnormal values had been excluded, the size and action direction (positive or negative) of the estimation coefficients were not significantly different from those of the benchmark regression.

To better explain the mutual impact of the economic scale, industrial structure, technological level, and environmental pollution, this study performed correlation analysis on the above variables, and the results are shown in Table 10. As can be seen from the table, there is a significant correlation between industrial structure and technological level, and economic scale is also significantly correlated with

Table 10: Correlation analysis of each variable.

	dlnso2	dlnfdi	dlngdp	dlnteca	dlnthi
dlnso2	1.0000				
dlnfdi	−0.1619 (0.0011)	1.0000			
dlngdp	0.3525 (0.0000)	−0.1714 (0.0005)	1.0000		
dlnteca	0.0430 (0.3898)	−0.0140 (0.7799)	0.1688 (0.0007)	1.0000	
dlnthi	0.1701 (0.0006)	−0.0731 (0.1430)	0.5401 (0.0000)	0.1438 (0.0038)	1.0000

Note. Data in the table are correlation coefficients, and the data in the brackets are p values.

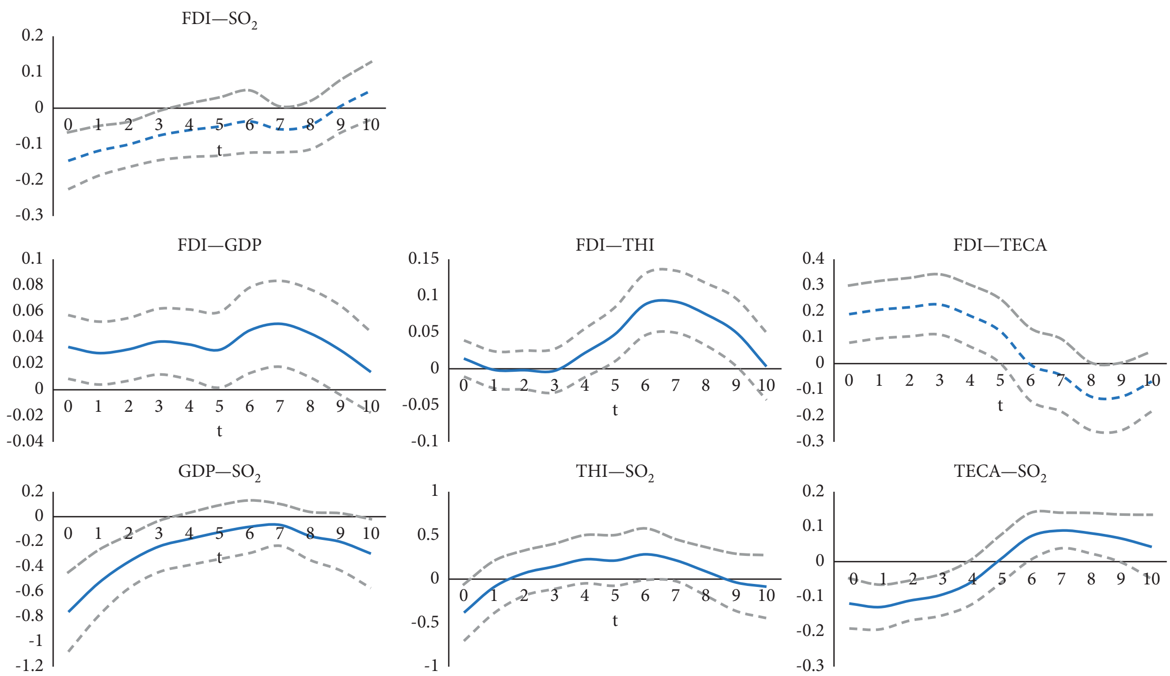

Figure 8: Change trend graph of influence effect among variables. Note: the ordinate is the influence coefficient. The blue solid line is the change trend of the influence effect, and the gray dotted line is the confidence interval. We performed pairwise OLS regression on the variables. The control variables include a series of control variables including the unemployment rate of each province, total capital formation, consumption expenditure, the proportion of students in colleges and universities per 100,000 population, and the area of urban garden green space. It is also derived from the China Statistical Yearbook and controls for time fixed effects and regional fixed effects.

industrial structure and technological level. The horizontal comparison of the impact of the three factors on environmental pollution is given in Figure 8. The economic scale has a negative impact on environmental pollution, and such impact reaches the maximum in the current period; the impact of industrial structure on environmental pollution changes from negative to positive, and the positive impact lasts longer; the technological level has a negative impact on environmental pollution within a short term, but then it turns to positive.

5. Conclusions

Through this research, we have drawn an enlightenment as follows: to correctly answer the question of "whether FDI can cause environmental pollution to the host country," it is necessary to determine the lag period of FDI at first; otherwise, there will be a systematic bias in the research conclusion if the lag period has been arbitrarily determined as 1 phase without analysis just as many other literature had performed. Second, the "fast or slow" impact of FDI on the host country's environment is another question that needs to be analyzed, and it is also a question involving whether the formulation of foreign investment policies, industrial policies, and environmental protection policies is timely and appropriate. Based on the PVAR model, this study explored the interaction of variables in the three models of "FDI, economic scale, and environmental pollution," "FDI, industrial structure, and environmental pollution," and "FDI, production technology, and environmental pollution," and the research results provided a piece of useful evidence for research on the environmental effects of DFI in China. The main conclusions obtained in this study are as follows:

(1) When studying the environmental effects of FDI, the choice of the optimal lag order is different under different action mechanisms. In this study, the optimal lag order for analyzing the dynamic impact

among FDI, economic scale, and environmental pollution was 1; the optimal lag order for analyzing the dynamic impact among FDI, industrial structure, and environmental pollution was 1; and the optimal lag order for analyzing the dynamic impact among FDI, technological level, and environmental pollution was 2.

(2) The expansion of economic scale and the development of tertiary industries such as commerce, catering, entertainment, and transportation will aggravate environmental pollution, but the improvement of technological level can significantly improve environmental quality. The expansion of the economic scale, the optimization of industrial structure, and the improvement of technological level are all processes of continuous development. A region with a better industrial structure will face a faster trend of high-quality development; when the economic scale has developed to a certain level, and the industrial structure has been optimized, then the growth rate of FDI attracted by this region will slow down, while the growth rate of FDI attracted by less-developed regions will be faster.

(3) In the two models of "FDI, economic scale, and environmental pollution" and "FDI, industrial structure, and environmental pollution," the impact lasted longer. Although the response reached the maximum within 2 periods and then gradually decreased, it existed all the time during the 10 periods; the response of environmental pollution to the technological level reached the maximum value between the fourth and the sixth periods, which has corresponded to the real situation that for any technology, it would require a transition period from the invention stage to the application in the actual production field.

(4) The environmental pollution effects of economic scale and industrial structure of the eastern region of China were the strongest, followed by the central region, and the western region came the last. Although FDI had shown an insignificant environmental damage effect under the action mechanism of economic scale, under the action mechanisms of industrial structure and technological level, the FDI of the eastern region showed an insignificant environmental improvement effect. The quality of FDI introduced into the eastern region was relatively high, and a considerable part had entered the tertiary industry, while the FDI of the central region had not exhibited a significant promotive effect on the development of the tertiary industry. In the central and western regions, the promotive effect of FDI on the technological level was mainly concentrated in the field of industrial production, so the pressure on the environment was higher; while in the eastern region, the FDI showed an environmental improvement effect.

Overall, FDI showed an environmental improvement effect in China, but it varied in terms of action mechanism and region. Under the action mechanism of the economic scale, FDI tended to damage the environment, and this effect was the strongest in the central region; under the action mechanism of industrial structure, FDI tended to improve the environment in the eastern and central regions of China, while the situation was the opposite for the western region; and under the action mechanism of technological level, FDI only showed a tendency of environmental improvement in the eastern region. All regions should attach importance to researching greener technologies, developing cleaner energies, and actively promoting the development of high-tech industries. Since the action between FDI and environmental pollution can last for a long time, it is necessary to view the impact of FDI on the environment in different periods from the perspective of long-term development. Moreover, until now China has not yet received the economic benefits that the FDI should have. In fact, FDI should be regarded as a carrier for introducing advanced technologies and management experiences; efforts should be made to actively introduce FDI with intensive capitals and technologies, and use the market mechanism to guide FDI and give full play to the resource allocation function of the market; in the future, we should have the right understandings of the environmental effects of FDI and give proper guidance to it, such as instructing its flow direction to low-polluting industries such as leasing service, information technology, new energy technology, and new material technology.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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